

FORM PTO-1390

U.S. Department of Commerce Patent and Trademark Office

Attorney's Docket No.

**TRANSMITTAL LETTER TO THE UNITED STATES  
DESIGNATED/ELECTED OFFICE (DO/EO/US)  
CONCERNING A FILING UNDER 35 U.S.C. 371**

2153-107

U.S. Application No. (if known, see 37 CFR 1.5)

**09/529440**

**INTERNATIONAL APPLICATION NO.**  
PCT/JP98/04391

**INTERNATIONAL FILING DATE**  
September 30, 1998

**PRIORITY DATE CLAIMED**  
September 30, 1998

**TITLE OF INVENTION**

TDMA WIRELESS COMMUNICATION SYSTEM, BASE STATION APPARATUS FOR WIRELESS COMMUNICATION, AND SUBSCRIBER STATION APPARATUS

**APPLICANT(S) FOR DO/EO/US**

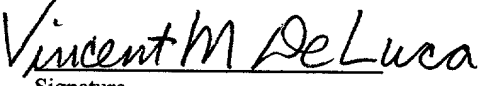
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Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☐ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
  - a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☒ has been transmitted by the International Bureau.
  - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
  - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
  - b. ☐ have been transmitted by the International Bureau.
  - c. ☐ have not been made; however, the time limit for making such amendments has **NOT** expired.
  - d. ☐ have not been made and will not be made.
8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

**ITEMS 11. TO 16. below concern other document(s) or information included:**

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☐ A **FIRST** preliminary amendment.  
☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
14. ☐ A substitute specification.
15. ☐ A change of power of attorney and/or address letter.
16. ☒ Other items or information:  
 - Inter. Search Report with cited references ( 6 )

|   |              |   |   |                                 |                     |
|---|--------------|---|---|---------------------------------|---------------------|
| U.S. APPLICATION NO. (If known, see 37 CFR 1.50)<br><b>09/529440</b>  |              | INTERNATIONAL APPLICATION NO.<br>PCT/JP98/04391 |   | ATTORNEY DOCKET NO.<br>2153-107 |                     |
| 17. <input checked="" type="checkbox"/> The following fees are submitted:<br><b>Basic National Fee (37 CFR 1.492)(a)(1)-(5):</b>  |              |   |   | <u>CALCULATIONS</u>             | <u>PTO USE ONLY</u> |
| Search Report has been prepared by the EPO or JPO   |              |   |   | \$ 840.00                       |                     |
| International preliminary examination fee paid to USPTO (37 CFR 1.482)  |              |   |   | \$ 670.00                       |                     |
| No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2))   |              |   |   | \$ 690.00                       |                     |
| Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO  |              |   |   | \$ 970.00                       |                     |
| International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4)   |              |   |   | \$ 96.00                        |                     |
| <b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>   |              |   |   | \$ 840.00                       |                     |
| Surcharge of \$130.00 for furnishing the oath or declaration later than [ ] 20 [ ] 30 months from the earliest claimed priority date (37 CFR 1.492(e)).   |              |   |   | \$                              |                     |
| Claims  | Number Filed | Number Extra                                    | Rate  |                                 |                     |
| Total Claims  | 15 -20 =     | 0   | X \$18.00   | \$                              |                     |
| Independent Claims  | 8 -3 =       | 5   | X \$78.00   | \$ 390.00                       |                     |
| Multiple dependent claim(s) (if applicable)   |              |   | + \$260.00  | \$                              |                     |
| <b>TOTAL OF ABOVE CALCULATIONS =</b>  |              |   |   | \$ 390.00                       |                     |
| Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).  |              |   |   | \$                              |                     |
| <b>SUBTOTAL =</b>   |              |   |   | \$                              |                     |
| Processing fee of \$130.00 for furnishing the English translation later [ ] 20 [ ] 30 than months from the earliest claimed priority date (37 CFR 1.492(f)).  |              |   |   | \$                              |                     |
| <b>TOTAL NATIONAL FEE =</b>   |              |   |   | \$1230.00                       |                     |
| Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property  |              |   |   | \$ 40.00                        |                     |
| <b>TOTAL FEES ENCLOSED =</b>  |              |   |   | \$1270.00                       |                     |
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| <b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b>                        |              |   |   |                                 |                     |
| SEND ALL CORRESPONDENCE TO:<br>Vincent M. DeLuca<br>Rothwell, Figg, Ernst & Kurz<br>555 13th St., N.W.<br>Washington, D.C. 20004<br>Phone: 202/783-6040   |              |   | <br>Signature<br><u>Vincent M. DeLuca</u><br>Name<br><u>32,408</u><br>Registration Number |                                 |                     |

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## SPECIFICATION

## 5

The present invention relates to a system for avoiding interference occurred in TDMA wireless communications.

In a cellular system in which a predetermined area is entirely covered by a plurality of base stations, a preselected number (for example, 7 pieces) of frequencies are repeatedly utilized, so that a two-dimensional service is available.

15           In such a so-called "POINT TO MULTI-POINT type"  
communication system (will be referred to as a "P-MP type  
communication system"), it is required to avoid interference  
occurred between a service area of an own station and a service  
area of another station using the same frequency as that of the  
20 first-mentioned station.

Generally speaking, in a fixed communication, such a system capable of avoiding interference with another service area by way of antenna directivity of both a base station and a subscriber station is employed. On the other hand, in a mobile

communication, there are provided a system in which when a base station is initiated, all of wireless carriers (radio carriers) allocated to the own stations are monitored to determine a use frequency, and also another system in which an occurrence of interference is sensed by measuring a bit error rate and the like of a reception signal, and then an interference packet is retransmitted and also a communication channel is changed.

However, in the system capable of realizing the two-dimensional fixed communication service by the base station installed on the ground, typically known as the P-MP fixed communication system, there is such a limitation that the occurrence of interference is avoided only by way of the antenna directivity due to complex geographical features present within the service area. Also, since the transfer band of the fixed communication system is wider than that of the mobile communication system, it is not preferable to avoid the occurrence of interference by arranging a large number of wireless carriers (like as the mobile communication) in view of effective frequency utilizations. Furthermore, considering storages of exclusively used line services, it is impossible to regularly block the base station so as to detect the occurrence of interference.

Also, as to the system for detecting the occurrence of interference by employing the bit error rate of the reception signal, since the reception side cannot recognize the presence

of the channel addressed to the own station before receiving this channel in the TDM line, even if interference happens to occur, the reception side cannot detect the occurrence of this interference.

5           In a TDMA type wireless communication system for executing a reallocation control and a rearrangement control, reliability of a control line through which a base station communicates with a subscriber station so as to execute the above-explained controls may adversely influence performance of  
10 the entire wireless communication system. In the reallocation control, a total number of allocation time slots are changed during communication in response to a change in a traffic. In the rearrangement control, time slot arrangements are changed. As a consequence, the error correction capability of the control line  
15 is emphasized, and also the same data is transferred by using the plural frames. However, in the fixed communication system, since the interference occurs in a fixed and periodical manner, the above-explained measures cannot become effective.

20           Moreover, in such a communication system that the bit error rate of the reception signal is measured so as to sense the occurrence of interference, and then the interference packet is retransmitted and/or the communication channel is changed, there is a certain possibility that the occurrence of such interference is erroneously detected due to adverse influences caused by



interference time slot database, wherein when interference is detected in a predetermined time slot received from a subscriber station, the interference time slot information is registered into the interference time slot database, and blocking information of an interference time slot is transmitted to the subscriber station; the time slot reallocation/rearrangement are carried out based upon registered information of the interference time slot database; and also time slot reallocation/rearrangement information is transmitted to the respective subscriber stations.

As a result, the interference which cannot be avoided by directivity of an antenna can be avoided, so that setting conditions of the base station can be largely mitigated.

Also, the present invention is directed to such a TDMA wireless communication system in which a base station communicates with a plurality of subscriber stations in a wireless manner, wherein the base station comprises: an interference time slot database for registering/storing therein a communication time slot in which interference happens to occur; and a TDMA control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in response to a change in a traffic based upon the interference time slot information of the interference time slot database, wherein when interference is detected in a predetermined time slot received from the base station, the subscriber station transmits

interference time slot information to the base station, and wherein the base station which has received the interference time slot information registers the interference time slot information into the interference time slot database, performs the time slot  
5 reallocation/rearrangement based upon registered information of the interference time slot database, and also transmits time slot reallocation/rearrangement information to the respective subscriber stations. As a result, it is possible to avoid the occurrence of interference which cannot be avoided by directivity  
10 of an antenna.

Also, the present invention is directed to such a TDMA wireless communication system in which a base station wireless-communicates with a plurality of subscriber stations by an up-stream line TDMA system and a down-stream line TDM system,  
15 wherein the base station comprises: an interference time slot database for registering/storing thereinto a communication time slot in which interference happens to occur; and a TDMA control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in response  
20 to a change in a traffic based upon the interference time slot information of the interference time slot database, and also transmits up-stream TDMA time slot reallocation/rearrangement information to the respective subscriber stations every predetermined frame in a down-stream TDM line, wherein each of



the subscriber stations monitors as to whether or not there is the up-stream TDMA time slot reallocation/rearrangement information addressed to the own subscriber station, which is transmitted from the base station every predetermined frame, and when the up-stream TDMA time slot reallocation/rearrangement information cannot be received, the subscriber station judges an occurrence of interference and transmits the occurrence of interference to the base station, and wherein the base station which has received the occurrence of interference registers the interference occurrence information into the interference time slot database, and transmits time slot reallocation/rearrangement information to the respective subscriber stations based on the registered information saved in the interference time slot database. As a result, a monitor circuit used to detect the interference of the TDM line is not especially provided, but the occurrence of interference can be readily detected.

Also, the present invention is directed to such a TDMA wireless communication system in which a base station communicates with a plurality of subscriber stations in a wireless manner, wherein time slot allocations/arrangements of the respective subscriber stations are changed all at once every super frame of a TDMA frame, and wherein a base station transmits to the respective subscriber stations, subsequent time slot

reallocation/rearrangement information with different time slot arrangements in a plurality of frames within a super frame period.

Accordingly, the time slot reallocation/rearrangement information can be firmly transmitted without receiving the  
5 adverse influence caused by the interference.

Also, the present invention is directed to such a base station apparatus in which while a service area of the own base station is subdivided into a plurality of sectors, the base station communicates with a plurality of subscriber stations in a TDMA  
10 wireless communication manner, comprising: an interference time slot database for registering/storing thereinto a communication time slot in which interference happens to occur; and a TDMA control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in  
15 response to a change in a traffic based upon the interference time slot information of the interference time slot database, wherein when the time slot reallocation/rearrangement are carried out, the TDMA control unit reallocates/rearranges the time slots in this order of a subscriber station of such a sector where no  
20 interference happens to occur, and thereafter, another subscriber station where interference does not occur among sectors where the interference occurs. Accordingly, probability where the interference happens to occur after the reallocation/rearrangement can be reduced.





can solve such a problem.

Also, the present invention is featured by that when the same interference time slot information whose total number is larger than, or equal to a preselected number is registered into  
5 the interference erroneous detection database within a predetermined time period, the base station apparatus increases an interference judging threshold value used to detect an occurrence of interference. As a consequence, it is possible to avoid the erroneous detection which is caused by the temporary  
10 deterioration in the communication quality, and also possible to prevent the line storage capability from being lowered.

Also, the present invention is directed to such a TDMA wireless communication system in which a base station communicates with a plurality of subscriber stations in a wireless  
15 manner, wherein the base station comprises: an interference time slot database for registering/storing thereinto a communication time slot in which interference happens to occur; and a TDMA control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in  
20 response to a change in a traffic based upon the interference time slot information of the interference time slot database, wherein when interference is detected in a predetermined time slot received from the base station, the subscriber station transmits interference time slot information to the base station, wherein



time slot database is registered into the interference erroneous detection database. As a result, such a time slot where the interference disappears can be effectively utilized in the reallocation/rearrangement.

5           Also, the present invention is featured by that when the same interference time slot information whose total number is larger than, or equal to a preselected number is registered into the interference erroneous detection database within a predetermined time period, an abnormal state is transmitted to  
10 a central station for managing the base station. As a result, it is possible to detect malfunction of the base station apparatus and an occurrence of an unexpected failure at an earlier stage, and also the base station apparatus can solve such a problem.

15           Also, the present invention is featured by that when the same interference time slot information whose total number is larger than, or equal to a preselected number is registered into the interference erroneous detection database within a predetermined time period, an interference judging threshold value used to detect interference is increased. As a consequence,  
20 it is possible to avoid the erroneous detection which is caused by the temporary deterioration in the communication quality, and also possible to prevent the line storage capability from being lowered.

Also, the present invention is directed to such a





Fig. 5 is a diagram showing a TDMA wireless communication system according to an embodiment mode 4 of the present invention.

Fig. 6 is a diagram showing a TDMA wireless communication system according to an embodiment mode 5 of the present invention.

5 Fig. 7 is a diagram showing a TDMA wireless communication system according to an embodiment mode 6 of the present invention.

Fig. 8 is a diagram showing a TDMA wireless communication system according to an embodiment mode 7 of the present invention.

10 Fig. 9 is a diagram showing a TDMA wireless communication system according to an embodiment mode 8 of the present invention.

Fig. 10 is a diagram showing a TDMA wireless communication system according to an embodiment mode 9 of the present invention.

Fig. 11 is a diagram showing a TDMA wireless communication system according to an embodiment mode 10 of the present invention.

#### 15 Best Mode for Carrying Out the Invention

For a more detailed description of the present invention, best modes for carrying out the present invention will now be explained with reference to the accompanying drawings.

#### 20 Embodiment Mode 1

Fig. 1 is a diagram showing an embodiment mode 1 according to the present invention.

In Fig. 1, it is now assumed that a base station 1 executes



the communication established between the base station 1 and the subscriber station 21 via the up-stream line 71. As a result, as shown in the drawing, as to a TDMA frame 311 of the base station 1, a portion of a time slot 411 cannot be received by this interference wave 51. This time slot 411 is allocated to the up-stream line 71 between the base station 1 and the subscriber station 21.

The base station 1 compares a bit error rate of a reception signal and a reception electric field strength with an interference judging threshold value so as to detect this occurrence, and then registers interference time slot information to an interference time slot database 101.

The TDMA control unit of the base station 1 makes a plan of time slot reallocation based upon communication request information issued from the subscriber stations 21 to 24 within a predetermined frame period, and at the same time, makes a plan of such a time slot rearrangement based upon the allocation time slot number (quantity) of each line and also interference time slot information registered in the interference time slot database 101. In this time slot rearrangement, the frame use efficiency can become optimum without using the interference time slot.

After the time slot information which has been reallocated/rearranged by the TDMA control unit is notified to



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TDMA frame 323 of the subscriber station 21, the subscriber station 21 detects an occurrence of interference based upon a bit error rate of a reception signal and a reception electric field strength, and then notifies this interference time slot 422 via the up-  
5 stream line 71 to the base station 1.

The base station 1 which has received the notification of the occurrence of interference from the subscriber station 21 registers interference time slot information to the interference time slot database 101.

10 Similar to the above-explained control case of the up-stream line, the TDMA control unit of the base station 1 schemes the time slot reallocation/rearrangement capable of avoiding this interference time slot with reference to the interference time slot database 101, and then notifies the schemed time slot  
15 reallocation/rearrangement to the respective subscriber stations 21 to 24. Thus, since the communication is commenced by the TDMA frame 325 with a new time slot arrangement, the adverse influence caused by the interference wave 52 from the base station 11 can be avoided.

20 In this case, the information about the time slot reallocation/rearrangement is notified to the respective subscriber stations 21 to 24 by using the down-stream line 61 in a time period up to one frame preceding to the TDMA frame 325. However, since the reliability of this down-stream line 61 is



up-stream line as well as the down-stream line connected between the base station 1 and the respective subscriber stations 21 to 24, a TDMA control unit of the base station 1 performs both a reallocation control and a rearrangement control, and may realize  
5 such a communication that a frame use efficiency becomes optimum among the base station 1 and the respective subscriber stations 21 to 24 in response to present conditions. While the reallocation control is carried out, a total number of allocation time slots to each traffic is regularly changed in response to  
10 a change in traffics when a call is made. While the rearrangement control is performed, the time slot arrangement is changed in response to a change in traffics.

Fig. 3 is a diagram showing a structure of a TDM down-stream line according to this embodiment mode. The communication  
15 required between the base station 1 and the subscriber stations 21 to 24 so as to control the time slot reallocation and the time slot rearrangement is carried out by employing a portion of the TDM channels allocated to each of the subscribers 21 to 24. In Fig. 3, reference numeral 422 indicates a TDMA channel of the  
20 subscriber station 21. This TDMA channel is arranged by a subscriber ID 4221, control information 4222, and also user data 4223.

In accordance with the TDM system, since the respective subscriber stations 21 to 24 cannot recognize in advance whether

or not information addressed to the own subscriber station is transmitted via which channel, the respective subscriber stations 21 to 24 sense the subscriber ID of the own subscriber station every frame so as to find out the channel addressed to the own subscriber station, so that the information addressed to the own subscriber station is received. Then, in the TDMA/TDM system according to this embodiment mode, reallocation/rearrangement information of an up-stream TDMA time slot of each of the subscriber stations 21 to 24 is transmitted as a portion of the respective user data to each of down-stream TDM frames.

Assuming now that a base station 11 installed at a position separated by a preselected distance from the base station 1 communicates with a subscriber station located within the own station service area 92 by using the same frequency as that of the base station 1, the electromagnetic wave transmitted from this base station 11 gives interference as an interference wave 52 to the communication established between the base station 1 and the subscriber station 21 via the down-stream line 61. As a result, as shown in Fig. 2 and Fig. 3, as to a down-stream TDM channel 422 established between the base station 1 and the subscriber station 21, a portion of a time slot cannot be received by this interference wave 52. As a consequence, the subscriber station 21 cannot recognize the TDM channel 422 addressed to the own subscriber station in this TDM frame 321.



As a consequence, since the subscriber station 21 cannot receive the information about the up-stream TDMA time slot reallocation/rearrangement in the TDM frame 321, this subscriber station 21 recognizes that interference happens to occur, and then notifies this fact to the base station 1 via the up-stream line 71. The information about the up-stream TDMA time slot reallocation/rearrangement should be notified every frame.

The base station 1 which has received the notification about the occurrence of interference from the subscriber station 21 registers interference time slot information related to the relevant TDM channel into the interference time slot database 101.

The TDMA control unit of the base station 1 makes a plan of time slot reallocation based upon communication request information issued from the subscriber stations 21 to 24 within a predetermined frame period, and at the same time, makes a plan of such a time slot rearrangement based upon the allocation time slot number (quantity) of each line and also interference time slot information registered in the interference time slot database 101.

In this time slot rearrangement, the frame use efficiency can become optimum. As a result, since the communication is commenced via a TDM frame 323 by a new time slot arrangement without using the interference time slot, the adverse influence caused by the interference wave 52 from the base station 11 can be avoided.

In this case, the information about the time slot

reallocation/rearrangement is notified to the respective subscriber stations 21 to 24 by using the down-stream line 61 in a time period up to one frame preceding to the TDMA frame 323.

Since the reliability of this down-stream line 61 is lowered due to the adverse influence caused by the interference wave 52, the base station 1 may newly set another down-stream line 62 which is exclusively used to transfer the information about the time slot reallocation/rearrangement with respect to the subscriber station 21. However, since the TDM system is employed in the down-stream line in this embodiment mode, a specific communication for setting the line is no longer required.

#### Embodiment Mode 3

Fig. 4 is a diagram showing an embodiment mode 3 according to the present invention. In this embodiment mode, information about time slot reallocation/rearrangement derived from the base station 1 is notified to the respective subscriber stations by using down-stream lines 611 to 613 and also down-stream lines 621 to 623, the time slot arrangements of which are different from each other in a plurality of frames of such a time period defined from a TDMA frame 321 up to one frame preceding to another TDMA frame. The TDMA frame 321 is such a frame immediately after time slot arrangements are changed all at once. In the TDMA frame 323, next time slot arrangements are changed all at once.



station 1 communicates with the subscriber stations 21 to 24 while  
a service area of the own base station 1 is subdivided into a  
plurality of sectors 911 to 916, and directivity antennas 111 to  
116 for covering the respective sectors 911 to 916 are switched  
5 in a time divisional manner.

It is now assumed that the base station 1 communicates  
with the respective subscriber stations 21 to 24, and both an  
up-stream line 71 of the subscriber station 21 and an up-stream  
line 72 of the subscriber station 22 are adversely influenced by  
10 interfere caused by electromagnetic waves 521 and 522 from base  
stations 11 and 12 of other service areas 921 and 922. As shown  
in Fig. 5, the interference time slot database 101 of the base  
station 1 manages the interference time slots every antenna sector  
and every subscriber station. In the case that the base station  
15 1 performs the time slot reallocation/rearrangement with respect  
to the respective subscriber stations 21 to 24, this base station  
1 allocates the time slots to firstly such a sector where no  
interference occurs and secondly such a subscriber station of the  
same sector, where no interference occurs in this order with having  
20 a priority order. As a consequence, probability when the  
interference again occurs can be reduced.

#### Embodiment Mode 5

Fig. 6 is a diagram showing an embodiment mode 5 according

to the present invention.

In this figure, it is now assumed that an electromagnetic wave transmitted from base station 1 gives interference as an interference wave 51 to such a time slot 411 which is allocated to an up-stream line 71 between the base station 1 and the subscriber station 21. The base station 1 communicates with the subscriber station 21 in such a manner that the base station 1 detects the interference and registers this time slot 411 into the interference time slot database 101 so as to block this time slot 411 and also to rearrange the up-stream line 71 to time slots 412 and 413. On the other hand, the base station 1 receives the blocked time slot 411 during a predetermined time period so as to detect as to whether or not an interference wave given to this time slot 411 is present.

When the interference wave of the interference time slot 411 cannot be detected, and furthermore, when the interference which has been once detected disappears later, the base station 1 releases the blocked time slot by deleting the registered time slot 411 from the interference time slot database 101. As a result, under the time slot reallocation/rearrangement control after releasing the blocked time slot, this relevant time slot 411 can be again allocated to the up-stream line 71. It should also be noted that this time slot 411 may be allocated to any line other than the up-stream line 71 in the time slot reallocation.

Embodiment Mode 6

Fig. 7 is a diagram showing an embodiment mode 6 according to the present invention.

5 In this figure, it is now assumed that a portion of a time slot 421 allocated to a down-stream line 61 cannot be received in a communication established between the base station 1 and the subscriber station 21 due to an interference wave 52 transmitted from the base station 11.

10 To detect the interference wave 52 occurred in the time slot 421 allocated to the down-stream line 61, the subscriber station 21 notifies via an up-stream line 71 to the base station 1, such a fact that the interference is detected from this relevant time slot 421. The TDMA control unit of the base station 1  
15 registers this time slot 421 into the interference time slot database 101 to thereby block this time slot 421, and then schemes to rearrange the down-stream line 61 to the time slot 422.

The base station 1 notifies the time slot reallocation/rearrangement via the down-stream line 61 to the  
20 subscriber station 21, and also receives the blocked time slot 421 for a predetermined time duration. Then, the base station 1 notifies to the subscriber station 21, such an instruction for detecting as to whether or not an interference wave given to this time slot 421 is present. At this time, as previously explained,

with reference to the preceding embodiment modes, the above-mentioned notification may be transferred by employing a control line 62 in order to secure reliability of the down-stream line.

5           After the interference time slot 421 has been blocked, the subscriber station 21 monitors a monitor signal transmitted from the base station 1 by this time slot 421. In the case that no interference wave cannot be detected and also the interference wave which has once detected disappears later, this subscriber  
10       station 21 requests the base station 1 via the up-stream line 71 to release the blocked time slot. The base station 1 which receives the request to release the blocked time slot releases blocking of this time slot by deleting the registered time slot 421 from the interference time slot database 101. As a result,  
15       under time slot reallocation/rearrangement executed after releasing of the blocked time slot, this time slot 421 may be allocated to a down-stream line 63 connected to another subscriber station 22. It should also be noted that the time slot 421 may be alternatively allocated to the original down-stream line 61  
20       in the time slot reallocation.

#### Embodiment Mode 7

Fig. 8 is a diagram showing an embodiment mode 7 according to the present invention.

In this figure, the base station 1 contains an interference time slot database 101 and an interference erroneous detection database 102. The base station 1 registers interference time slot information into the interference time slot database 101. This interference time slot information is detected by the base station 1 and the subscriber station 21 within the service area 91 of the own base station 1. When the base station 1 reallocates and rearranges the time slots with respect to the respective lines, this base station excludes the relevant interference time slot from the time slots to be allocated and blocks the excluded interference time slot.

First, in the case that the base station 1 detects interference, the base station 1 monitors such a time slot that the own base station 1 detects the interference and blocks the interference time slot for a predetermined time period so as to detect as to whether or not an interference wave is present. In the case that either the interference wave cannot be detected or the interference wave which has been once detected disappears later, the base station 1 deletes the information of this relevant time slot from the interference time slot database 101 so as to release blocking of this time slot. At the same time, the base station 1 registers the information of this time slot into the interference erroneous detection database 102.

Next, in the case that the subscriber station 21 detects



an occurrence of interference, the base station 1 causes this subscriber station 21 to monitor such a blocked time slot for a predetermined time period in order to detect as to whether or not the interference wave is present. This blocked time slot is produced by such a result that this subscriber station 21 detects the interference. In such a case that either the interference wave cannot be detected or the interference wave which has been once detected disappears later, the subscriber station 21 registers the information of this relevant time slot into an interference erroneous detection database 202 of the own subscriber station 21. At the same time, this subscriber station 21 notifies such a fact that the interference wave cannot be detected to the base station 1. When the base station 1 receives such a notification that no interference wave can be detected from the subscriber station 21, this base station 1 deletes the information about this interference time slot from the interference time slot database 101, and then releases blocking of this interference time slot.

It should be noted that in this embodiment mode, the interference erroneous detection database is also provided in the side of the subscriber station 21. Alternatively, the information about the interference erroneous detection in the subscriber station 21 may be also registered into the interference erroneous detection database 102 provided on the side of the base

station 1 and may be managed in a batch mode.

While the base station 1 regularly monitors the information saved in the interference erroneous detection database 102, in the case that a total number of interference erroneous detections every predetermined time period exceeds a reference value, the base station 1 notifies this fact to a central control station 81 via a backbone line 8. In the case that the subscriber station 21 owns the interference erroneous detection database 202, while the subscriber station 21 monitors the information saved in the interference erroneous detection database 202, in the case that a total number of interference erroneous detections in the own subscriber station every predetermined time period is reached to a reference value or more, the subscriber station 21 notifies deterioration in the interference erroneous detection rate to the base station 1. The base station 1 which has received the notification about the deterioration in the interference erroneous detection rate from the subscriber station 21 notifies this fact to the central control station 81 via the backbone line 8. As a result, it is possible to discover the occurrences of the malfunction and failure in the apparatus at an earlier stage.

#### Embodiment Mode 8

Fig. 9 is a diagram showing an embodiment mode 8 according

to the present invention.

In this figure, the base station 1 contains an interference time slot database 101 and an interference erroneous detection database 102. The base station 1 registers  
5 interference time slot information into the interference time slot database 101. This interference time slot information is detected by the base station 1. When the base station 1 reallocates and rearranges the time slots with respect to the respective lines, this base station excludes the relevant  
10 interference time slot from the time slots to be allocated and blocks the excluded interference time slot.

Subsequently, the base station 1 monitors such a time slot that the own base station 1 detects the interference to block the time slot so as to detect as to whether or not an interference  
15 wave is present. In the case that either the interference wave cannot be detected or the interference wave which has been once detected disappears later, the base station 1 deletes the information of this relevant time slot from the interference time slot database 101 so as to release blocking of this time slot.

20 At the same time, the base station 1 registers the information of this time slot into the interference erroneous detection database 102.

The information saved in the interference erroneous detection database 102 of the base station 1 is used to judge the

erroneous detection time and then is reset every time a time period managed by a timer 103 has passed. In such a case that the base station 1 judges that the erroneous detection time exceeds a reference value, this base station 1 is operated in such a manner that interference erroneous detection probability is lowered by increasing a threshold value of an interference detecting means provided in the own base station. Even when the threshold value is increased up to an upper limit value, if the erroneous detection probability is not lowered, then the base station 1 judges a line failure 104 and thus issues an alarm via the backbone line to the central control station. In other words, such an erroneous detection caused by temporary communication quality deteriorations such as variations in space propagation losses may be avoided by increasing the threshold value of the interference detecting means. However, even when the threshold value is increased up to the upper limit value, in the case that the erroneous detection probability is not lowered, an occurrence of either malfunction or failure may be predicted. As a result, the base station 1 issues an alarm.

#### Embodiment Mode 9

Fig. 10 is a diagram showing an embodiment mode 9 according to the present invention.

In this figure, the base station 1 contains an

interference time slot database 101 and an interference erroneous detection database 102. The base station 1 registers interference time slot information into the interference time slot database 101. This interference time slot information is detected by the subscriber station 2 within the service area of the own base station 1, and is notified via the up-stream line 71. When the base station 1 reallocates and rearranges the time slots with respect to the respective lines, this base station excludes the relevant interference time slot from the time slots to be allocated and blocks the excluded interference time slot.

The base station 1 causes the subscriber station 2 to monitor such a time slot that this subscriber station 2 detects the interference and blocks the interference time slot for a predetermined time period so as to detect as to whether or not an interference wave is present. In the case that either the interference wave cannot be detected or the interference wave which has been once detected disappears later, the subscriber station 2 notifies such a fact that the interference wave cannot be detected to the base station 1. Upon receipt of this notification, the base station 1 deletes the information of this relevant time slot from the interference time slot database 101 so as to release blocking of this time slot. At the same time, the base station 1 registers the information of this time slot

into the interference erroneous detection database 102.

The information saved in the interference erroneous detection database 102 of the base station 1 is used to judge the erroneous detection time and then is reset every time a time period  
5 managed by a timer 103 has passed. In such a case that the base station 1 judges that the erroneous detection time of the subscriber station 2 exceeds a reference value, this base station 1 instructs the subscriber station 2 to increase a threshold value of an interference detecting means provided in the own subscriber  
10 station. Even when the threshold value of the subscriber station 2 is increased up to an upper limit value, if the erroneous detection probability is not lowered, then the base station 1 judges a line failure 104 and thus issues an alarm via the backbone line to the central control station.

15 Alternatively, when the subscriber station 2 is required to change the threshold value by the base station 1, the subscriber station 2 is operated to change this threshold value. At the same time, this subscriber station 2 may actuate the own timer 203, and may control such that the threshold value is returned to the  
20 original value after predetermined time has elapsed. As a result, the base station 1 is no longer required to manage the interference detection threshold values of all of the subscriber stations, so that the processing work load given to the base station 1 can be reduced.

Embodiment Mode 10

Fig. 11 is a diagram showing an embodiment mode 10 according to the present invention.

5 In this figure, the base station 1 contains an interference time slot database 101 and an interference erroneous detection database 102. The base station 1 registers interference time slot information into the interference time slot database 101. This interference time slot information is  
10 detected by the subscriber station 2 within the service area of the own base station 1 and is notified via the up-stream line 71.

When the base station 1 reallocates and rearranges the time slots with respect to the respective lines, this base station excludes the relevant interference time slot from the time slots to be  
15 allocated and blocks the excluded interference time slot.

The subscriber station 2 monitors such a time slot which is blocked by the base station 1 in response to the notification of the own subscriber station 2 for a predetermined time period in order to check as to whether or not an interference wave is  
20 present. In the case that either the interference wave cannot be detected by the subscriber station 2 or the interference wave which has been once detected disappears later, this subscriber station 2 registers the information of this interference time slot into the interference erroneous detection database 202 of the own





# CLAIMS

1. A base station apparatus for communicating with a plurality of subscriber stations in a TDMA wireless communication manner, comprising:

5 an interference time slot database for registering/storing therein a communication time slot in which interference happens to occur; and a TDMA control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in response to a change  
10 in a traffic based upon the interference time slot information of the interference time slot database,

wherein when interference is detected in a predetermined time slot received from a subscriber station, said interference time slot information is registered into said interference time slot database, and blocking information of an interference time  
15 slot is transmitted to said subscriber station; the time slot reallocation/rearrangement are carried out based upon registered information of said interference time slot database; and also time slot reallocation/rearrangement information is transmitted to  
20 the respective subscriber stations.

2. A TDMA wireless communication system in which a base station communicates with a plurality of subscriber stations in a wireless manner,

wherein the base station comprises: an interference time

slot database for registering/storing therein a communication time slot in which interference happens to occur; and a TDMA control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in response to a change in a traffic based upon the interference time slot information of the interference time slot database,

wherein when interference is detected in a predetermined time slot received from the base station, said subscriber station transmits interference time slot information to said base station,

wherein the base station which has received the interference time slot information registers said interference time slot information into said interference time slot database, performs the time slot reallocation/rearrangement based upon registered information of said interference time slot database, and also transmits time slot reallocation/rearrangement information to the respective subscriber stations.

3. A TDMA wireless communication system in which a base station wireless-communicates with a plurality of subscriber stations by an up-stream line TDMA system and a down-stream line TDM system,

wherein the base station comprises: an interference time slot database for registering/storing therein a communication time slot in which interference happens to occur; and a TDMA

control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in response to a change in a traffic based upon the interference time slot information of the interference time slot database, and also  
5 transmits up-stream TDMA time slot reallocation/rearrangement information to the respective subscriber stations every predetermined frame in a down-stream TDM line,

wherein each of said subscriber stations monitors as to whether or not there is the up-stream TDMA time slot  
10 reallocation/rearrangement information addressed to the own subscriber station, which is transmitted from said base station every predetermined frame, and when said up-stream TDMA time slot reallocation/rearrangement information cannot be received, said subscriber station judges an occurrence of interference and  
15 transmits said occurrence of interference to the base station, and

wherein the base station which has received the occurrence of interference registers the interference occurrence information into said interference time slot database, and  
20 transmits time slot reallocation/rearrangement information to the respective subscriber stations based on the registered information saved in the interference time slot database.

4. A TDMA wireless communication system in which a base station communicates with a plurality of subscriber stations in

a wireless manner,

wherein time slot allocations/arrangements of the respective subscriber stations are changed all at once every super frame of a TDMA frame, and

5 wherein a base station transmits to the respective subscriber stations, subsequent time slot reallocation/rearrangement information with different time slot arrangements in a plurality of frames within a super frame period.

10 5. A base station apparatus in which while a service area of the own base station is subdivided into a plurality of sectors, the base station communicates with a plurality of subscriber stations in a TDMA wireless communication manner, comprising:

an interference time slot database for  
15 registering/storing therein a communication time slot in which interference happens to occur; and a TDMA control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in response to a change in a traffic based upon the interference time slot information  
20 of the interference time slot database,

wherein when the time slot reallocation/rearrangement are carried out, the TDMA control unit reallocates/rearranges the time slots in this order of a subscriber station of such a sector where no interference happens to occur, and thereafter, another

subscriber station where interference does not occur among sectors where the interference occurs.

6. The base station apparatus as claimed in claim 5, wherein the interference time slot database manages the  
5 interference time slot information every sector.

7. A base station apparatus for communicating with a plurality of subscriber stations in a TDMA wireless communication manner, comprising:

an interference time slot database for  
10 registering/storing thereinto a communication time slot in which interference happens to occur; and

a TDMA control unit for executing  
reallocation/rearrangement of time slots communicating with the  
respective subscriber stations in response to a change in a traffic  
15 based upon the interference time slot information of the  
interference time slot database,

wherein when interference is detected in a predetermined  
time slot received from a subscriber station, said interference  
time slot information is registered into said interference time  
slot database, and blocking information of an interference time  
20 slot is transmitted to said subscriber station; the time slot  
reallocation/rearrangement are carried out based upon registered  
information of said interference time slot database; and also time  
slot reallocation/rearrangement information is transmitted to

the respective subscriber stations, and

wherein on the other hand, in the case that said interference time slot is received for a predetermined time period and the interference disappears, the interference time slot information registered into said interference time slot database is deleted therefrom.

8. The base station apparatus as claimed in claim 7, wherein said base station apparatus comprises an interference erroneous detection database, and registers said interference time slot information which has been deleted from said interference time slot database into said interference erroneous detection database.

9. The base station apparatus as claimed in claim 8, wherein when the same interference time slot information whose total number is larger than, or equal to a preselected number is registered into the interference erroneous detection database within a predetermined time period, said base station apparatus transmits an abnormal state to a central station for managing the base station.

10. The base station apparatus as claimed in claim 8, wherein when the same interference time slot information whose total number is larger than, or equal to a preselected number is registered into the interference erroneous detection database within a predetermined time period, said base station apparatus

increases an interference judging threshold value used to detect an occurrence of interference.

11. A TDMA wireless communication system in which a base station communicates with a plurality of subscriber stations in a wireless manner,

wherein the base station comprises: an interference time slot database for registering/storing thereinto a communication time slot in which interference happens to occur; and a TDMA control unit for executing reallocation/rearrangement of time slots communicating with the respective subscriber stations in response to a change in a traffic based upon the interference time slot information of the interference time slot database,

wherein when interference is detected in a predetermined time slot received from the base station, said subscriber station transmits interference time slot information to said base station,

wherein the base station which has received the interference time slot information registers said interference time slot information into said interference time slot database, performs the time slot reallocation/rearrangement based upon registered information of said interference time slot database, transmits time slot reallocation/rearrangement information to the respective subscriber stations, and on the other hand, transmits an instruction signal to said subscriber station, said

instruction signal causing said subscriber station to receive said interference time slot for a predetermined time period, and

wherein said subscriber station which has received said instruction signal receives said interference time slot for a predetermined time period, and when the interference disappears, said subscriber station sends a request to said base station, said request requesting a deletion of said interference time slot information registered into said interference time slot data.

12. The TDMA wireless communication system as claimed in claim 11, wherein an interference erroneous detection database is provided on the side of either the base station or the subscriber station, and the interference time slot information deleted from the interference time slot database is registered into said interference erroneous detection database.

13. The TDMA wireless communication system as claimed in claim 12, wherein when the same interference time slot information whose total number is larger than, or equal to a preselected number is registered into the interference erroneous detection database within a predetermined time period, an abnormal state is transmitted to a central station for managing the base station.

14. The TDMA wireless communication system as claimed in claim 12, wherein when the same interference time slot information whose total number is larger than, or equal to a preselected number is registered into the interference erroneous detection database



within a predetermined time period, an interference judging threshold value used to detect interference is increased.

15. A subscriber station apparatus for communicating with a base station in a TDMA wireless communication manner,

5            wherein when interference is detected in a predetermined time slot received from the base station, said subscriber station apparatus transmits interference time slot information to said base station, and when said subscriber station receives said interference time slot for a predetermined time period and the  
10 interference disappears, said subscriber station transmits interference disappear information to said base station.

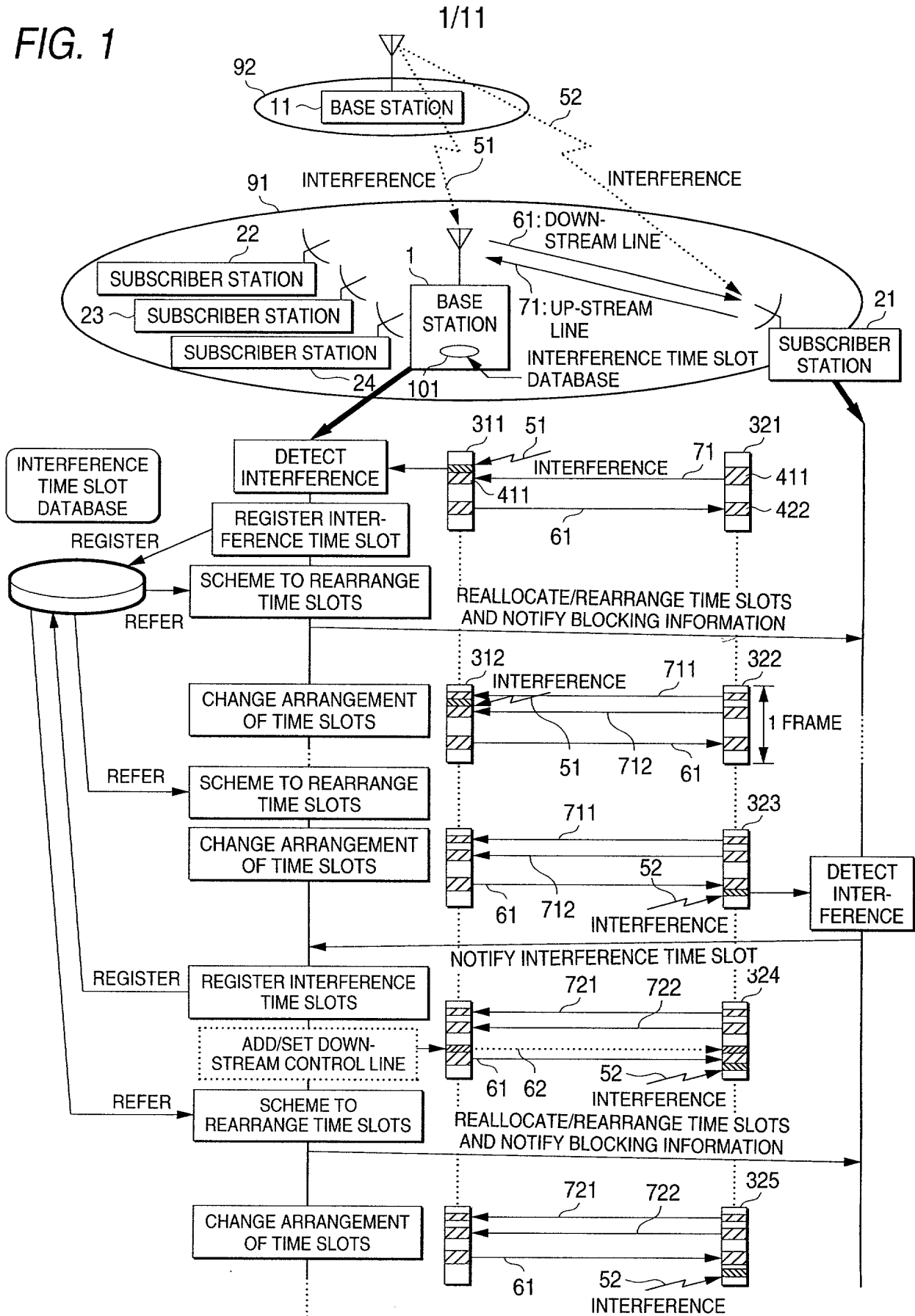
ABSTRACT

In a TDMA communication system in which a base station communicates with a plurality of subscriber stations, communication time slots used in a wireless communication are allocated/arranged while avoiding an occurrence of interference.

In the case that interference (51) occurs in a communication time slot (411) of a line (71) through which the communication is made from a subscriber station (21) to a base station (1), interference information is registered into an interference time slot database (101) of the base station (1).

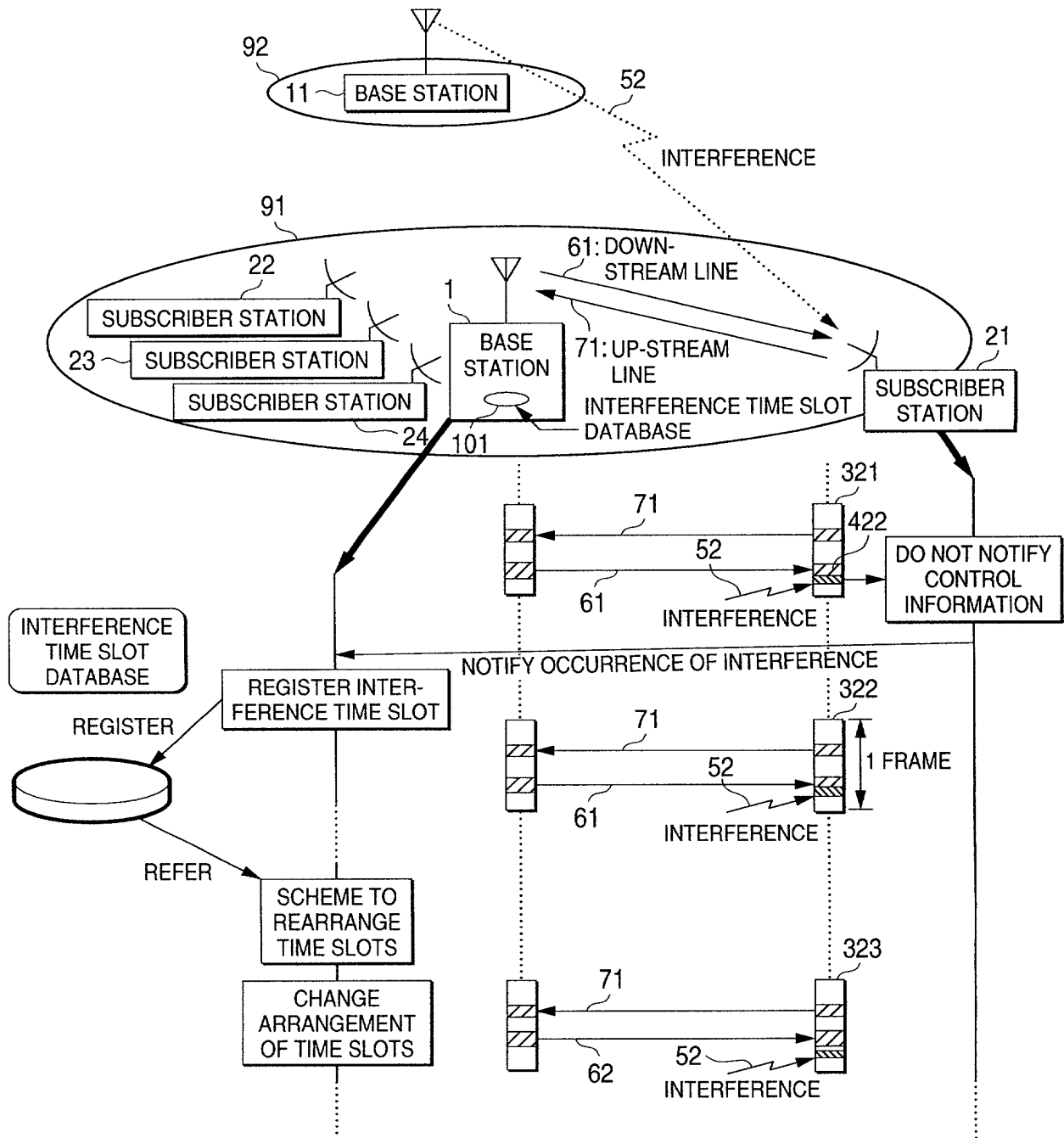
When the communication time slots are reallocated and rearranged, a TDMA control unit of the base station (1) executes the communication time slot reallocation/rearrangement by referring to information registered in the interference time slot database (101), so that the occurrence of interference is avoided.

1/11



2/11

FIG. 2



**FIG. 3**

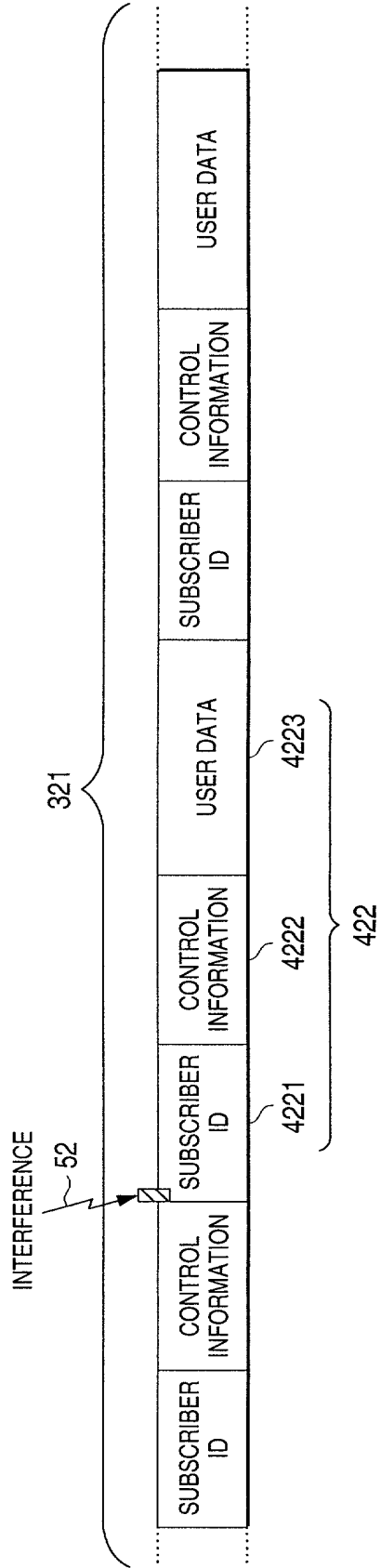




Figure 1 illustrates a mobile communication system 101. The system includes a central Base Station 113 and several Subscriber Stations 21, 22, 23, 24, 911, 912, 913, 914, and 915. Downstream lines (61, 62, 63, 64, 65) and upstream lines (71, 72, 73, 74, 75) connect the stations. Interference is shown as dotted lines from external Base Stations 11 and 12 (921, 922) to the system. An Interference Time Slot Database 101 is shown with a table of interference data.

| SECTOR | SLOT | SUBSCRIBER NUMBER | INTERFERENCE |
|--------|------|-------------------|--------------|
| 1      | 150  | 22                | YES          |
|        | 220  | 24                | NO           |
| 2      | 45   | 23                | NO           |
| 3      |      |                   |              |
| 4      |      |                   |              |
| 5      | 648  | 21                | YES          |
| 6      |      |                   |              |

| SECTOR | SLOT | SUBSCRIBER NUMBER | INTERFERENCE |
|--------|------|-------------------|--------------|
| 1      | 150  | 22                | YES          |
|        | 220  | 24                | NO           |
| 2      | 45   | 23                | NO           |
| 3      |      |                   |              |
| 4      |      |                   |              |
| 5      | 648  | 21                | YES          |
| 6      |      |                   |              |

FIG. 6

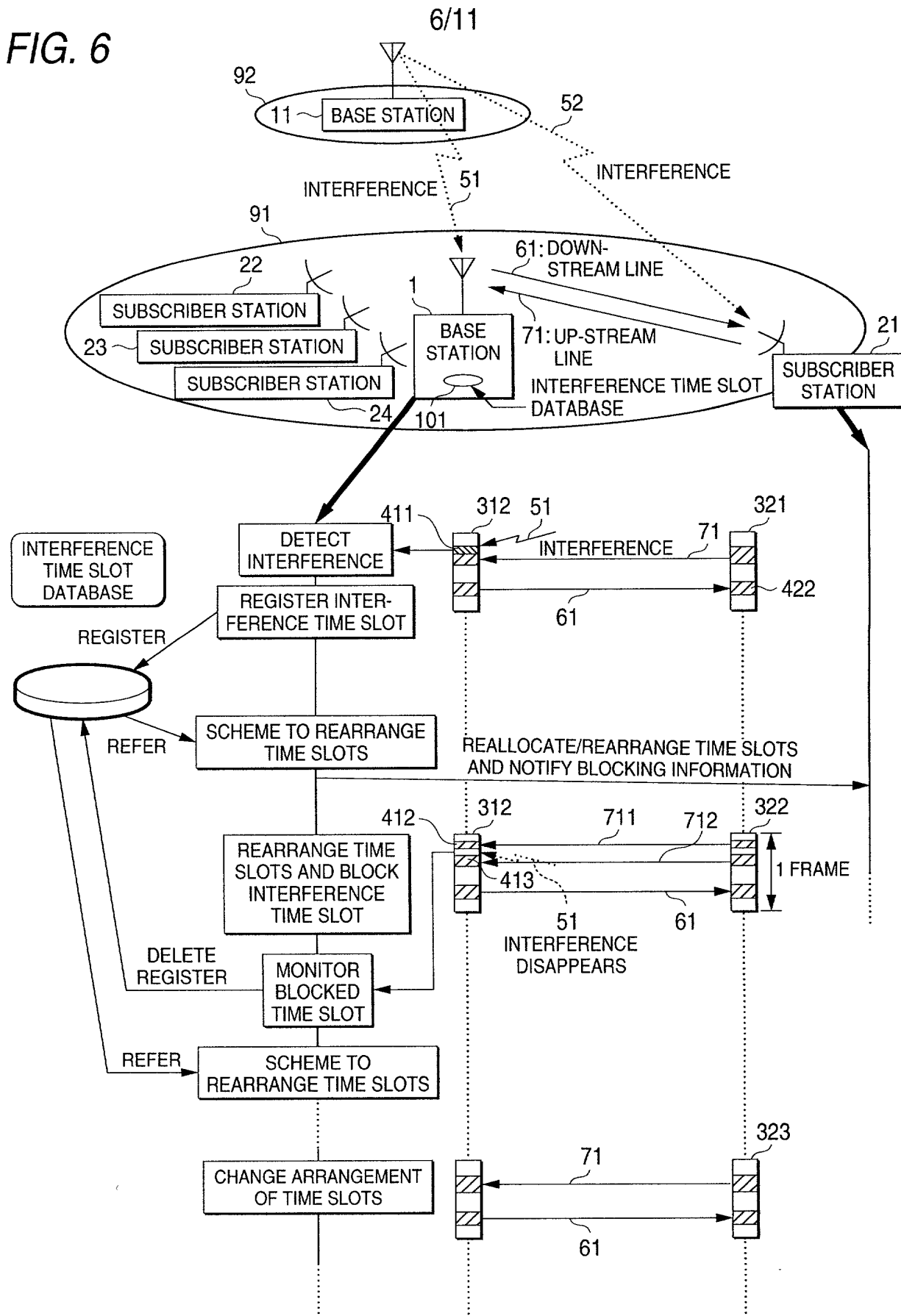
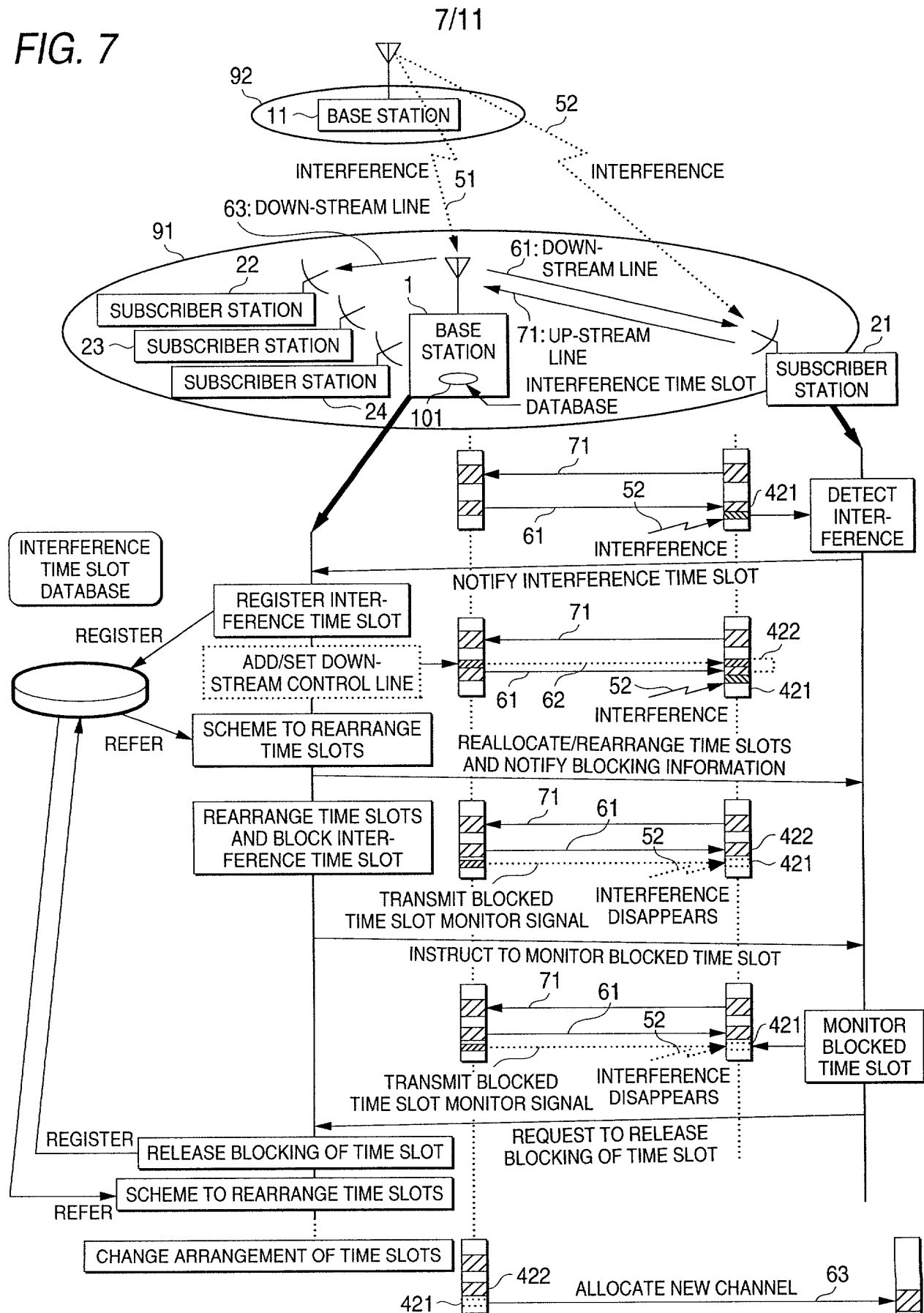




FIG. 7





**FIG. 9**

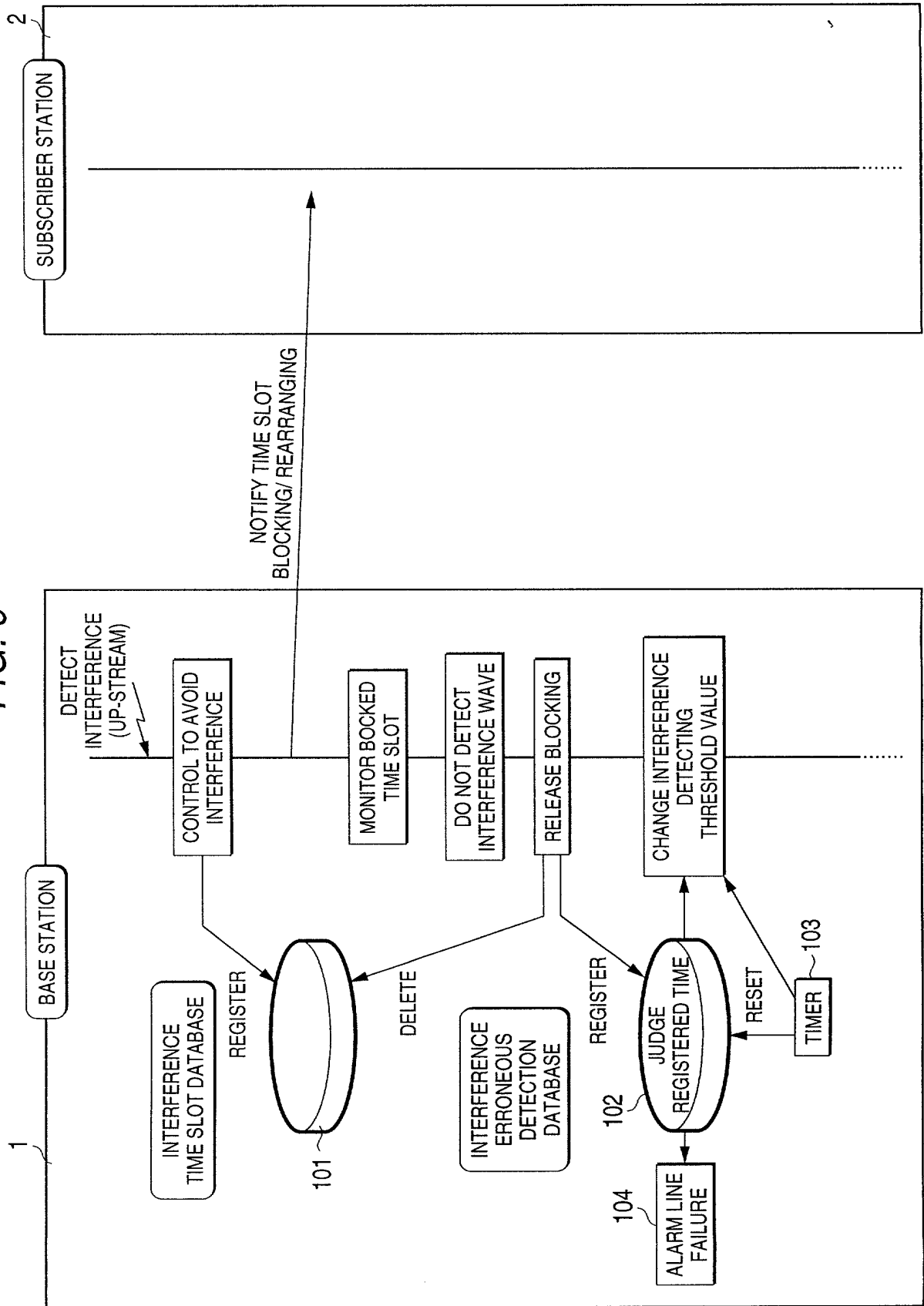


FIG. 10

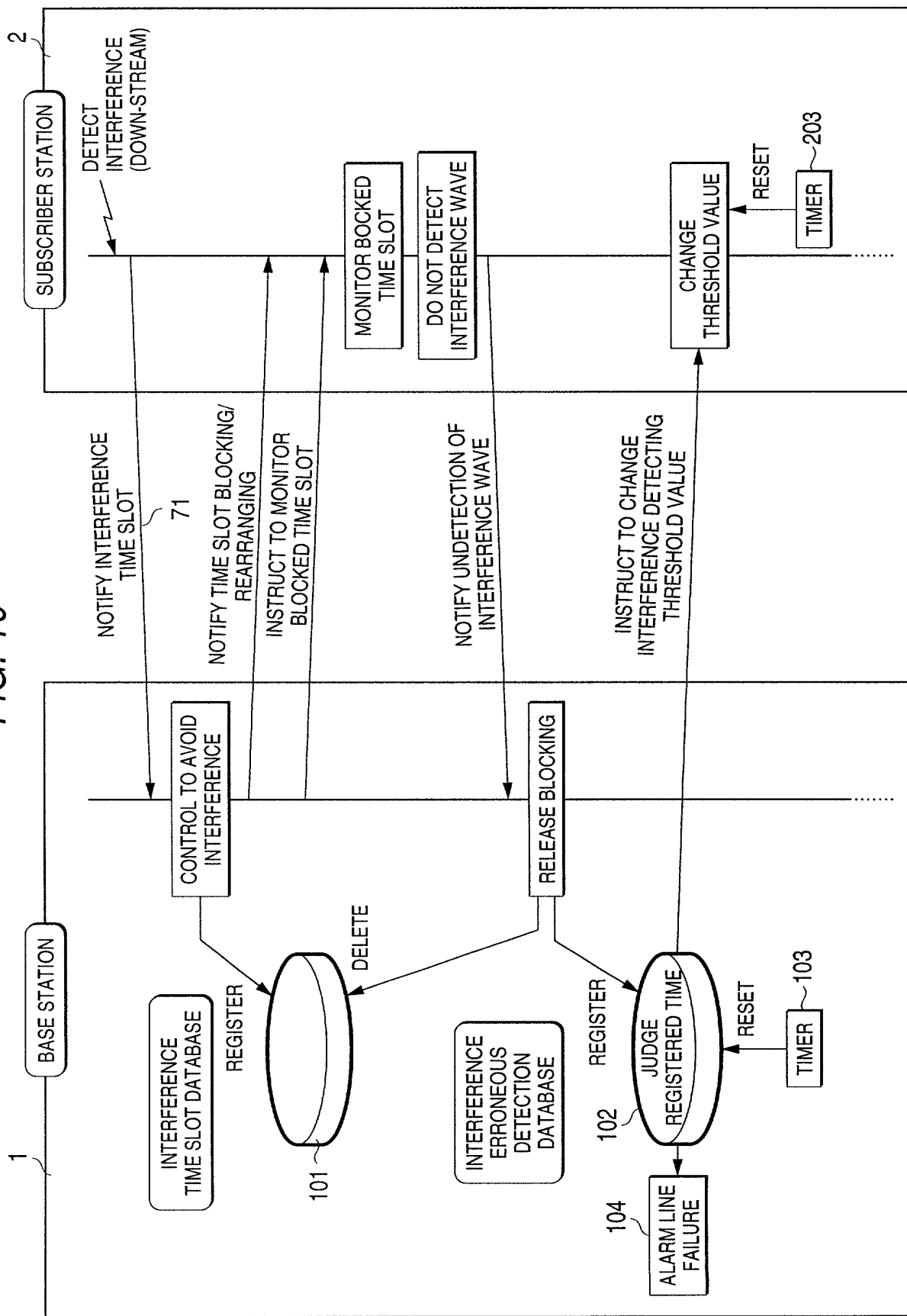
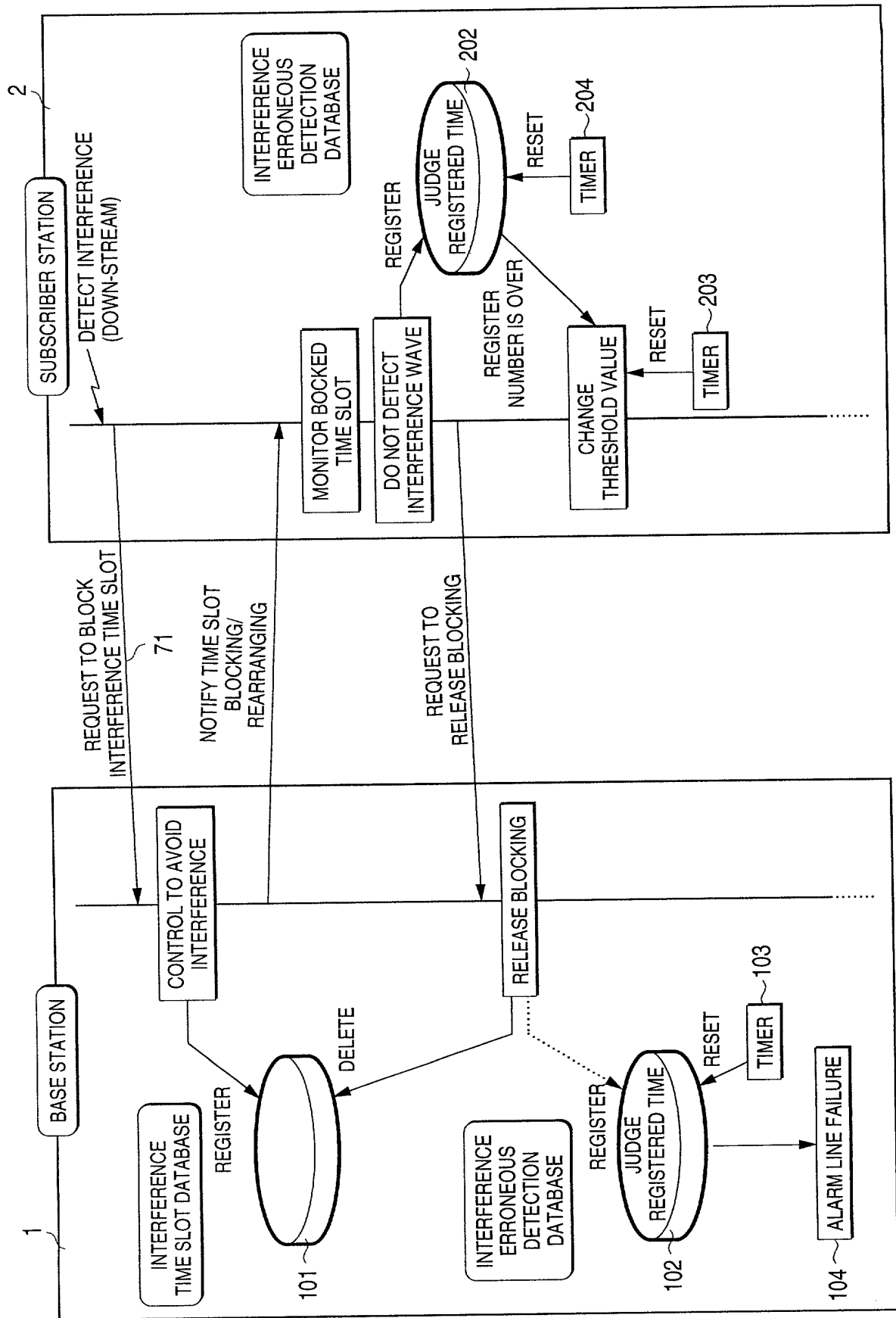


FIG. 11



# COMBINED DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

## 特許出願宣言書

### Japanese Language Declaration

私は、下欄に氏名を記載した発明者として、以下のとおり宣言する：

私の住所、郵便の宛先および国籍は、下欄に氏名に続いて記載したとおりであり、

名称の発明に関し、請求の範囲に記載した特許を求める主題の本来の、最初にして唯一の発明者である（一人の氏名のみが下欄に記載されている場合）か、もしくは本来の、最初にして共同の発明者である（複数の氏名が下欄に記載されている場合）と信じ、

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as state below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**TDMA WIRELESS COMMUNICATION SYSTEM,**

**BASE STATION APPARATUS FOR WIRELESS**

**COMMUNICATION, AND SUBSCRIBER STATION APPARATUS**

その明細書を  
(該当する方に印を付す)

☐ ここに添付する。

☐ \_\_\_\_\_ 日に出願番号

第 \_\_\_\_\_ 号として提出し、

\_\_\_\_\_ 日に補正した。

(該当する場合)

the specification of which  
(check one)

☐ is attached hereto.

☒ was filed on September 30, 1998 as

**PCT International**

Application Serial No. PCT/JP98/04391

and was amended on \_\_\_\_\_

(if applicable)

私は、前記のとおり補正した請求の範囲を含む前記明細書の内容を検討し、理解したことを陳述する。

私は、連邦規則法典第37部第1章第56条項に従い、本願の審査に所要の情報を開示すべき義務を有することを認める。

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56.

## Japanese Language Declaration

私は、合衆国法典第35部第119条、第172条、又は第365条に基づく下記の外国特許出願または発明者証出願の外国優先権利益を主張し、さらに優先権の主張に係わる基礎出願の出願日前の出願日を有する外国特許出願または発明者証出願を以下に明記する:

Prior foreign applications

先の外国出願

|                  |                   |                                    |
|------------------|-------------------|------------------------------------|
| (Number)<br>(番号) | (Country)<br>(国名) | (Day/Month/Year Filed)<br>(出願の年月日) |
| (Number)<br>(番号) | (Country)<br>(国名) | (Day/Month/Year Filed)<br>(出願の年月日) |
| (Number)<br>(番号) | (Country)<br>(国名) | (Day/Month/Year Filed)<br>(出願の年月日) |
| (Number)<br>(番号) | (Country)<br>(国名) | (Day/Month/Year Filed)<br>(出願の年月日) |
| (Number)<br>(番号) | (Country)<br>(国名) | (Day/Month/Year Filed)<br>(出願の年月日) |

私は、合衆国法典第35部第120条にもとづく下記の合衆国特許出願の利益を主張し、本願の請求の範囲各項に記載の主題が合衆国法典第35部第112条第1項に規程の態様で先の合衆国出願に開示されていない限度において、先の出願の出願日と本願の国内出願日またはPCT国際出願日の間に公表された連邦規則法典第37部第1章第56条項に記載の所要の情報を開示すべき義務を有することを認める。

|                                    |                        |
|------------------------------------|------------------------|
| (Application Serial No.)<br>(出願番号) | (Filing Date)<br>(出願日) |
| (Application Serial No.)<br>(出願番号) | (Filing Date)<br>(出願日) |

私は、ここに自己の知識にもとづいて行った陳述がすべて真実であり、自己の有する情報および信ずるところに従って行った陳述が真実であると信じ、さらに故意に虚偽の陳述等を行った場合、合衆国法典第18部第1001条により、罰金もしくは禁錮に処せられるか、またはこれらの刑が併科され、またかかる故意による虚偽の陳述が本願ないし本願に対して付与される特許の有効性を損なうことがあることを認識して、以上の陳述を行ったことを宣言する。

I hereby claim foreign priority benefits under Title 35, United States Code, §119, §172, or §365 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Priority claimed

優先権の主張

|                                       |                                      |
|---------------------------------------|--------------------------------------|
| <input type="checkbox"/><br>Yes<br>あり | <input type="checkbox"/><br>No<br>なし |
| <input type="checkbox"/><br>Yes<br>あり | <input type="checkbox"/><br>No<br>なし |
| <input type="checkbox"/><br>Yes<br>あり | <input type="checkbox"/><br>No<br>なし |
| <input type="checkbox"/><br>Yes<br>あり | <input type="checkbox"/><br>No<br>なし |
| <input type="checkbox"/><br>Yes<br>あり | <input type="checkbox"/><br>No<br>なし |

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56 which occurred between the filing date of the prior application and the national or PCT international filing date of this application:

|                         |  |
|-------------------------|--|
| (現況)<br>(特許済み、係属中、放棄済み) | (Status)<br>(patented, pending, abandoned) |
| (現況)<br>(特許済み、係属中、放棄済み) | (Status)<br>(patented, pending, abandoned) |

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

# Japanese Language Declaration

委任状: 私は、下記発明者として、以下の代理人をここに選任し、本願の手続きを遂行すること並びにこれに関する一切の行為を特許商標庁に対して行うことを委任する。  
(代理人氏名および登録番号を明記のこと)

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) and/or agent(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith. (list name and registration number)

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Barbara G. Ernst, Reg. No. 30,377;  
George R. Repper, Reg. No. 31,414;  
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Joseph A. Hynds, Reg. No. 34,627;  
Michael G. Sullivan, Reg. No. 35,377;  
Michael J. Lynch, Reg. No. 36,403;  
Christiana M. Gadiano, Reg. No. 37,628;  
Jeffrey B. McIntyre, Reg. No. 36,867;  
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and Barbara W. Walker, Reg. No. 35,400

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|                      |  |   |
|----------------------|--|---|
| 唯一のまたは第一の発明者の氏名      | Full name of sole or first inventor<br><b>Tomokazu HAMADA</b>  |   |
| 同発明者の署名              | 日付   | Inventor's signature Date<br><i>Tomokazu Hamada</i> April 5, 2000         |
| 住所                   | Residence<br><b>Tokyo, Japan Jpx</b>   |   |
| 国籍                   | Citizenship<br><b>Japan</b>  |   |
| 郵便の宛先                | Post Office Address<br><b>c/o Mitsubishi Denki Kabushiki Kaisha,<br/>2-3, Marunouchi 2-Chome, Chiyoda-ku,<br/>Tokyo 100-8310 JAPAN</b> |   |
| 第二の共同発明者の氏名 (該当する場合) | Full name of second joint inventor, if any<br><b>Youichi MORITANI</b>  |   |
| 同第二発明者の署名            | 日付   | Second inventor's signature Date<br><i>Youichi Moritani</i> April 5, 2000 |
| 住所                   | Residence<br><b>Tokyo, Japan Jpx</b>   |   |
| 国籍                   | Citizenship<br><b>Japan</b>  |   |
| 郵便の宛先                | Post Office Address<br><b>c/o Mitsubishi Denki Kabushiki Kaisha,<br/>2-3, Marunouchi 2-Chome, Chiyoda-ku,<br/>Tokyo 100-8310 JAPAN</b> |   |

(第三またはそれ以降の共同発明者に対しても同様な情報および署名を提供すること。)

(Supply similar information and signature for third and subsequent joint inventors)



|                      |    |  |                       |
|----------------------|----|--|-----------------------|
| 第三の共同発明者の氏名 (該当する場合) |    | Full name of third joint inventor, if any<br><u>Takashi KAWABATA</u>   |                       |
| 同第三発明者の署名            | 日付 | Third inventor's signature<br><u>Takashi Kawabata</u>  | Date<br>April 5, 2000 |
| 住所                   |    | Residence<br><u>Tokyo, Japan</u>   |                       |
| 国籍                   |    | Citizenship<br><u>Japan</u>  |                       |
| 郵便の宛先                |    | Post Office Address<br><u>c/o Mitsubishi Denki Kabushiki Kaisha,</u><br><u>2-3, Marunouchi 2-Chome, Chiyoda-ku,</u><br><u>Tokyo 100-8310 JAPAN</u> |                       |
| 第四の共同発明者の氏名 (該当する場合) |    | Full name of fourth joint inventor, if any<br><u>Shuji ITO</u>   |                       |
| 同第四発明者の署名            | 日付 | Fourth inventor's signature<br><u>Shuji Ito</u>  | Date<br>April 5, 2000 |
| 住所                   |    | Residence<br><u>Tokyo, Japan</u>   |                       |
| 国籍                   |    | Citizenship<br><u>Japan</u>  |                       |
| 郵便の宛先                |    | Post Office Address<br><u>c/o Mitsubishi Denki Kabushiki Kaisha,</u><br><u>2-3, Marunouchi 2-Chome, Chiyoda-ku,</u><br><u>Tokyo 100-8310 JAPAN</u> |                       |
| 第五の共同発明者の氏名 (該当する場合) |    | Full name of fifth joint inventor, if any  |                       |
| 同第五発明者の署名            | 日付 | Fifth inventor's signature   | Date                  |
| 住所                   |    | Residence  |                       |
| 国籍                   |    | Citizenship  |                       |
| 郵便の宛先                |    | Post Office Address  |                       |
| 第六の共同発明者の氏名 (該当する場合) |    | Full name of sixth joint inventor, if any  |                       |
| 同第六発明者の署名            | 日付 | Sixth inventor's signature   | Date                  |
| 住所                   |    | Residence  |                       |
| 国籍                   |    | Citizenship  |                       |
| 郵便の宛先                |    | Post Office Address  |                       |